

## Exhibit E-1

The table below shows third party uses of "BRUX" on their websites and/or in articles

Exhibit No.	Description (Emphasis added)	Website
E-2	<b>CDL BRUX- C</b> - Full Contour All Zirconia Crown	<a href="http://www.colonialdentallab.com/products.htm">http://www.colonialdentallab.com/products.htm</a>
E-3	BRUX+ - Combination Guard	<a href="http://www.tridentlab.com/products/bite.asp#bite3">http://www.tridentlab.com/products/bite.asp#bite3</a>
E-4	<b>BRUXGUARD</b> - Occlusal Splint	<a href="http://shererdentallab.com/products/bruxguard_testimonials.asp">http://shererdentallab.com/products/bruxguard_testimonials.asp</a>
E-5	Soft <b>Brux</b> Guard; Hard/Soft <b>Brux</b> Guard; Hard <b>Brux</b> Guard; Talon-type <b>Brux</b> Guard	<a href="http://www.technicdentallab.com/orthodontic.asp">http://www.technicdentallab.com/orthodontic.asp</a>
E-6	<b>BRUXTECH DENTAL LAB</b>	<a href="http://www.bruxtech.com/home.html">http://www.bruxtech.com/home.html</a>
E-7	<b>Z-BRUX</b> - Zirconia Restoration	<a href="http://www.dentistrytoday.com/new-products/3499-zirconia-restoration-assured-dental-lab">http://www.dentistrytoday.com/new-products/3499-zirconia-restoration-assured-dental-lab</a>
E-8	Article: <i>A Changing Direction in Dentistry: Full-Contour Zirconia</i> by Robin A. Carden Note: <u>Glidewell's Robin Carden (senior director of Glidewell Laboratories</u> materials research and development) <u>cites Z-BRUX as a viable competitor of Glidewell's BruxZir</u> product in this article.	<a href="http://www.jdtunbound.com/files/pdf-files/The%20Educated%20Technician.pdf">http://www.jdtunbound.com/files/pdf-files/The%20Educated%20Technician.pdf</a>
E-9	Lakeside Dental Laboratory	<a href="http://ldlwi.com/index.htm">http://ldlwi.com/index.htm</a> <a href="http://ldlwi.com/cudahy-wi-z-brux-dental-products.htm">http://ldlwi.com/cudahy-wi-z-brux-dental-products.htm</a>
E-10	T. Kato, <i>Overview of sleep bruxism: history and on the way we are</i> , Sleep Medicine, 8 Suppl. 1 (2007), S21.A.	<a href="http://www.deepdyve.com/lp/elsevier/s21-a-overview-of-sleep-bruxism-history-and-on-the-way-we-are-C5GWtipE00">http://www.deepdyve.com/lp/elsevier/s21-a-overview-of-sleep-bruxism-history-and-on-the-way-we-are-C5GWtipE00</a>
E-11	Ramfjord, Sigurd P., <i>Dysfunctional temporomandibular joint and muscle pain</i> , Journal of Prosthetic Dentistry, Vol. 11, Issue 2, pgs. 353-374, March <u>1961</u> .	<a href="http://www.thejpd.org/article/0022-3913(61)90212-8/abstract">http://www.thejpd.org/article/0022-3913(61)90212-8/abstract</a>
E-12	Weinberg, Lawrence A., <i>Incisal and condylar guidance in relation to cuspal inclination in lateral excursions</i> , Journal of Prosthetic Dentistry, Vol. 9, Issue 5, pgs. 851-862, Sept. <u>1959</u> .	<a href="http://www.thejpd.org/article/0022-3913(59)90051-4/abstract">http://www.thejpd.org/article/0022-3913(59)90051-4/abstract</a>
E-13	Brecker, S. Charles., <i>Conservative occlusal rehabilitation</i> , Journal of Prosthetic Dentistry, Vol. 9, Issue 6, pgs. 1001-1016, Nov. <u>1959</u> .	<a href="http://www.thejpd.org/article/0022-3913(59)90160-X/abstract">http://www.thejpd.org/article/0022-3913(59)90160-X/abstract</a>
E-14	Teeth Grinding ( <b>Bruxism</b> ) blog	<a href="http://teeth-grinding.blogspot.com/">http://teeth-grinding.blogspot.com/</a>

## Exhibit E-2

<http://www.colonialdentallab.com/products.htm>

### CDL BRUX- C

#### Full Contour All Zirconia Crown

##### Call for Details

**CDL BRUX- C** is a full contoured Zirconia Crown, fabricated using CAD/CAM Technology. Resistant to fracturing and chipping. It is a practical solution for your bruxism patients. Rather than prescribe a full metal crown or a PFM with a metal occlusal, consider the strong and economical **CDL BRUX- C** crown from Colonial Dental Lab

## Exhibit E-3

<http://www.tridentlab.com/products/bite.asp#bite3>


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## Bite Splints and Sports Guards



**Tri-Splint**



**BRUX+**

**Mouth Guard**

[Tri-Flex](#)

[Fabrication Components](#)

[Order a Starter Kit](#)

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Three of Trident's exclusive products, the Tri-Splint, BiteSoft, and Brux +, are often prescribed to provide an optimal and effective solution to overcoming clenching and grinding. Unique within itself, the BiteSoft Anterior Splint is a custom-fit mouth piece worn over only the six anterior teeth during sleep to establish jaw stability and relaxation. In today's world, Sports Mouth Guards are ideal for any active sport such as; football, hockey, boxing, and skateboarding. Custom-fitted sports guards are tailored to the individual's oral shape to provide an advantage over boil and bite mouth guards purchased in stores. Better retention means better protection all around!

**\* BENEFITS OF BITE SPLINTS / BITE & SPORTS GUARDS:**

- Excellent Fit and Retention
- Comfortable to Wear
- Dependable
- Durable
- Wear Resistant




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**Tri-Splint**

- Available as:
  - Soft Splint
  - Hard Splint
- Indicated for maxillary and mandibular arches

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**BRUX+**

- Combination guard with a hard outer surface plus a comfortable soft inner liner

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**Mouth Guard**

- Ideal for protection during high impact sports
- Variety of colors offered
- A helmet strap is optional

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## Exhibit E-4

[http://shererdentallab.com/products/bruxguard\\_testimonials.asp](http://shererdentallab.com/products/bruxguard_testimonials.asp)



# SHERER DENTAL LAB



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## PRODUCTS

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### What others are saying about BRUXGUARD Occlusal Splints

"In February 1999, impressions were taken on a patient for fabrication of the Bruxguard appliance. In February 2002, she returned for the delivery of the appliance. After running hot tap water over the appliance, I seated it and checked the occlusion, which was perfect. Chair time was 3 minutes - after the appliance sat in my lab for 3 years! Unbelievable."

—Dr. Ben Jett, Columbia, SC

"Since I have been using the Bruxguard splint, my delivery chair-time has decreased by at least 50%."

—Dr. Steve Hix, Huntersville, NC

- Patient comfort and compliance excellent with Bruxguard
- Much easier to fit and adjust
- Better retention
- Better success adjusting to fit over a new crown or restoration

—Dr. Pamela Linker, Harrisburg, NC

"Occlusal guards or different styles of occlusal appliances can be challenging to fit the comfort of patients and for them to wear on a consistent basis. Sherer meets the challenge by being willing to have outstanding fit and to design the occlusal guard to best meet the needs of the patient. We have been working with Sherer for years and I love their precise care."

—Dr. Jane Parker, Matthews, NC

"Bruxguard splints are the best! So much easier to work with than acrylic splints. They always

## Exhibit E-5

<http://www.technicdentallab.com/orthodontic.asp>



**Technic**  
Dental Lab

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Toll Free (866) 799-3939  
mail@technicdentallab.com

Technology That Produces *Shining* Results

# Orthodontic Appliances

#### Retainers:

- Hawley Retainer
- Spring Hawley Retainer
- Modified Spring Retainer
- Bonded Lingual Retainer
- QCM Retainer
- EZ Bond
- Color Guide



#### Fixed appliances:

- Pendulum/Penguin
- Space Maintainers
- Nance Holding Arch
- Lingual Holding Arch
- Transpalatal Arch



#### Mouthguards:

- Soft Brux Guard
- Hard/Soft Brux Guard
- Bleaching Tray
- Surgical Template
- Implant Stents
- TAP Snore Guard



#### Expansion appliances:

- Haas
- Sagittals
- Schwarz Design
- Rapid Palatal Expander
- Nord
- PendeX



#### Splints (bruxism):

- Hard Brux Guard
- TMJ Sprint (cold cure)
- Gelb-Mora
- Lars
- Impak Bionator
- Talon-type Brux Guard

## Exhibit E-6

<http://www.bruxtech.com/home.html>

**BRUXTECH DENTAL LAB**  
"For the daily grind"

457-0704

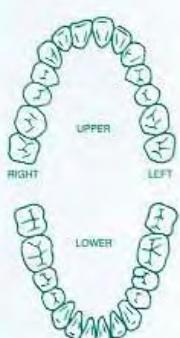
Date: \_\_\_\_\_

Doctor \_\_\_\_\_

Address \_\_\_\_\_

Phone \_\_\_\_\_

Patient	Date Required	
<input type="checkbox"/> Nightguard	<input type="checkbox"/> Upper	<input type="checkbox"/> Thermoflex
<input type="checkbox"/> Reline	<input type="checkbox"/> Lower	<input type="checkbox"/> Hard Acrylic
<input type="checkbox"/> Repair	<input type="checkbox"/> Shade	<input type="checkbox"/> Mold



DDS

**BRUXTECH DENTAL LAB**  
Edmonton Alberta Canada  
Phone 780-457-0704

Bruxtech Dental Lab is one of the only labs in Canada with a focus on the production of the highest quality nightguards. We have over 10 years experience in gnathology and use only the finest materials. To review the manufacturing process, take a look through our photo gallery!

**BRUXTECH PRICELIST**  
Prices are subject to change without notice

We always try to keep our prices amongst the lowest in Edmonton, without sacrificing quality. All splints, sportsguards, and bleaching trays come with an ortho box.

Twin-Cure (Max-160.00 Mand-160.00)



## Exhibit E-7

<http://www.dentistrytoday.com/new-products/3499-zirconia-restoration-assured-dental-lab>

### ZIRCONIA RESTORATION - Assured Dental Lab

Written by Dentistry Today

Z-Brux is a 100%, full-milled pure zirconia restoration; there is no porcelain overlay to create porcelain fractures. Due to the aesthetic qualities of Z-Brux's zirconia and its 1,000 MPa flexural strength, it is a great alternative to a PFM with a metal occlusal or a full-cast gold crown. Half the price of a gold crown, Z-Brux offers adjustability, stainability, and excellent marginal fit. For more information, call [\(877\) 283-5351](tel:8772835351) or visit [assureddentallab.com](http://assureddentallab.com).



## Exhibit E-8

<http://www.jdtunbound.com/files/pdf-files/The%20Educated%20Technician.pdf>

Full contour zirconia captures the industry.

# A Changing Direction in Dentistry: Full-Contour Zirconia

By Robin A. Carden

Zirconia is one of the most studied ceramic materials in the world for uses ranging from telecommunications to the new energy of the future to environmentally-friendly products. In clinical dentistry, it is widely used for the fabrication of crown copings, bridge frameworks and custom implant abutments. Its durability, biocompatibility, natural esthetics and low cost when compared to alternative restorative materials make it the ideal solution for a variety of clinical applications. More recently, dental use is trending toward full-contour (monolithic) zirconia — that is, solid zirconia restorations with no porcelain overlay. Ongoing material advancements have produced the strongest and most reliable all-ceramic restoration to date, making zirconia an ideal alternative solution wherever traditional metal or PFM restorations might be prescribed.



**Figure 1**  
(Above)  
Zirconia  
Powder

**Figure 2**  
(Right)  
BlueZir  
Banks

### Material Origins

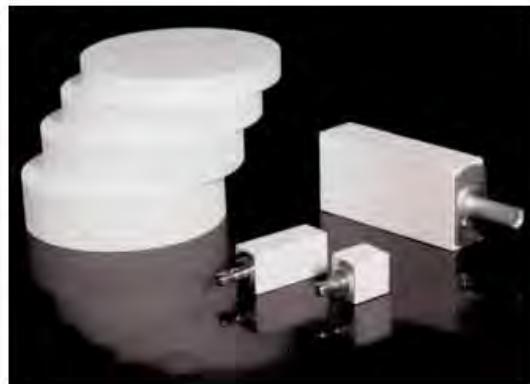
Zirconia, or zirconium oxide, is the common name for the chemical compound zirconium dioxide ( $ZrO_2$ ). The material is commercially available in two basic forms. The first of these is naturally derived from the mineral Baddeleyite. The second is synthetically derived from zircon sand ( $ZrSiO_4$ ) using a solid state reaction process. Several oxides such as magnesium oxide ( $MgO$ ), yttrium oxide ( $Y_2O_3$ ), calcium oxide ( $CaO$ ), cerium (III) oxide ( $Ce_2O_3$ ),

and others are added to zirconia in order to stabilize the tetragonal and/or cubic phases. The resulting material, often referred to as yttria-stabilized zirconia (YSZ), exhibits superior strength and flexibility, surpassing the mechanical limitations of traditional fine ceramics.

### Material Advantages

The fast-growing popularity of full-contour zirconia is easy to understand when observing several material advantages:

1. **High Flexural Strength** — Full-contour zirconia products on the market today boast flexural strength ranging anywhere from 850MPa to 1,465MPa. These higher-level strength increases have been achieved through the use of post-powder processing. When compared to the flexural strength of porcelain ceramics, with typical ranges of 71MPa (feldspathic porcelain) to 419MPa (In-Ceram), the zirconia strength advantage becomes clear.
2. **High Fracture Toughness (K<sub>IC</sub> Value)** — Strength and toughness are not necessarily related. Brittle materials may exhibit significant tensile strength by supporting a



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static load, whereas toughness indicates how much energy a material can absorb before mechanical failure. Also thought of as impact resistance, fracture toughness is a quantitative property that describes the ability of a material with inherent microstructural flaws to resist fracture via crack growth and propagation. A piece of lead or steel has high fracture toughness and will generally encounter ductile fracture, characterized by extensive plastic deformation prior to structural failure. Materials such as glass and traditional glass-ceramics typically exhibit low and inconsistent fracture toughness, and are prone to brittle fracture, characterized by a lack of apparent plastic deformation prior to structural failure. Thus, fracture toughness becomes one of the most important properties of any brittle material for virtually all design applications. The fracture toughness for partially stabilized zirconia is naturally high because of an internal mechanism that actually inhibits crack propagation. Inside, cubic grains are constraining the tetragonal precipitates that want to expand and release associated energy. When these grains are faced with a propagating crack tip, the tetragonal phase is released and allowed to change back to the



**Figure 3 (Left)**  
Monolock BruxZir



**Figure 4 (Below)**  
Monolock Full Cast

more stable monoclinic phase. This results in an associated volumetric expansion, effectively closing the advancing crack. Known as phase transformation toughening, this unique self-healing event gives partially stabilized zirconia a fracture toughness that is three to six times higher than normal zirconia and most other ceramics. Even so, ongoing methods are being devised to modify the yield strength, ductility and fracture toughness of both crystalline and amorphous materials, including zirconia. For instance, consolidation processes are being used to reduce grain size. Because crack propagation through a material's grain boundaries is deflected by the material's grains, a material consisting of smaller grains becomes inherently stronger, as there are more grains to absorb energy from the force of the crack.

Whereas a crack in a traditional ceramic travels all the way through the material with little inhibition, transformation toughening represents a breakthrough in achieving all-ceramic materials with a high value for fracture toughness. Today's partially stabilized zirconia is so tough that it can be struck with a hammer or fabricated into a hammer for driving nails.

3. **Resistance to Thermal Shock** — Zirconia has relatively low thermal expansion numbers, giving it

## Understanding Zirconia

**Names:** Zirconia, zirconium oxide, zirconium dioxide ( $ZrO_2$ ), yttria-stabilized zirconia (YSZ)

**Terms:**

**Phase Transformation Toughening:** The naturally occurring process by which cubic grains within stabilized zirconia constrain tetragonal precipitates, effectively closing advancing cracks and resulting in a sort of self-healing of the material.

**Fracture Toughness:** A property that describes the ability of a material with inherent microstructural flaws to resist fracture via crack growth and propagation.

**Plasticity:** The deformation of a material undergoing non-reversible changes of shape in response to applied forces.

**Brittle Fracture:** No apparent plastic deformation takes place before fracture.

**Ductile Fracture:** Extensive plastic deformation takes place, characterized by slow propagation and absorption of large amounts of energy, before fracture.

excellent resistance to thermal shock. This means it will remain very stable in the mouth and will face fewer stress factors resulting from expansion and contraction.

4. **Improved Esthetics** — If there has been a complaint regarding full-contour zirconia to date, it would be that its opaque white hue lacks the translucent, ivory shade of natural teeth. Zirconia can be stained and glazed to a prescribed tooth shade, but has still been limited by a lack of inherent translucency. However, consolidation processes in the laboratory that initially focused on improving strength through reduced particle size have led to related innovations in material translucency. These advancements, along with improved blending processes, allow the purest zirconia powder to be changed into an ivory shade that is more lifelike than the typical snow-white zirconia. Whereas full-contour zirconia is typically prescribed only for posterior restorations, newer clinical cases have shown it to blend in reasonably well with anterior teeth. These continuing enhancements in color and translucency, to go along with the elimination of dark gingival lines associated with traditional PFM restorations, give rising hope to full-contour zirconia becoming an acceptable anterior restorative.
5. **Improved Wear Compatibility** — Diamond-polishing a full-contour zirconia crown provides longterm life for opposing enamel surfaces. This wear compatibility has been validated in enamel wear in-vitro studies, and clinical studies are also under way. A 2010 comparative wear study conducted by professor Dr. J. Geis-Gerstorfer and sponsored by Glidewell Dental Laboratories used the Willytech Chewing Simulator to



**Figure 5 (Above)**  
Monocap Metal Occlusal

simulate the clinical performance of both BruxZir Solid Zirconia and Ceramco<sup>®</sup>3 porcelain over a period of five years. The reported findings stated that, after 1.2 million wear cycles under a load of 5 kg, the wear of the antagonist situation (Stearite ball) was found to be significantly lower with BruxZir ( $72 \pm 21 \mu\text{m}$ ) than with Ceramco<sup>®</sup>3 ( $110 \pm 48 \mu\text{m}$ ).

6. **Cost** — A discussion of the benefits offered by full-contour zirconia would not be complete without mentioning cost factors. Despite its many material advantages, zirconia is considerably less expensive than traditional, precious metal.

### Indications

Full-contour zirconia is indicated for posterior crowns, crowns over implants and crowns with limited occlusal clearance. It is also indicated for full-arch bridges up to 14 units. Primary candidates include bruxers and grinders who do not desire cast gold or metal occlusal PFM restorations. For esthetic reasons, it is recommended that a facial veneer of porcelain be used on any zirconia-based anterior restoration. However, full-contour zirconia may be used in specific anterior cases where a dentist wishes to emphasize the strength of the restoration over its esthetics.

### Availability

Commercially available zirconia blanks for in-lab milling include brands such as BruxZir, Sagemax HT, Crystal Diamond Zirconia, Zirlux, Prettau and

### JDT Unbound

The Journal of Dental Technology and JDT Unbound have covered zirconia extensively. Search our archives at [www.jdtunbound.com](http://www.jdtunbound.com) to find out more about this material.

Origin. Prescribed crowns include brands such as BruxZir, Suntech FC, Z-Brux, and TRICONIA.

Due to its high flexural strength, high fracture toughness, resistance to thermal shock, metal-free esthetics and terrific wear compatibility, full-contour zirconia is an ideal material for dental restorations. It also boasts excellent contours and contacts for desired marginal fit, conventional chamfer prep and cementation, and affordability for both clinicians and their patients. Prescribed almost exclusively for posterior restorations, material advancements may make it an acceptable solution for some anterior restorations as well, further fueling its popularity as the material of choice for dental restorations today. **JDT**

### About the Author:

Carden founded Talon Composites, the manufacturer of Talbor, a composite material that uses advanced ceramics and metals. To date, he holds more than 25 patents, mostly related to metal and ceramic composites. In 1998, he won the Design Engineering Award from Design News. He is also the inventor of the translucent orthodontic braces for 3M™ ESPE™ and Ceradyne Inc. Presently, he works at Glidewell Laboratories as senior director of research and development.



## Exhibit E-9

<http://ldwi.com/index.htm>



**Lakeside Dental Laboratory**  
866-606-5958

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**Cudahy, WI Dental Laboratory**  
Nation Wide  
Lakeside Dental Lab

Since 1975, Lakeside Dental Lab of Cudahy, WI has been offering quality dental products to dentists Nation Wide. We have served our clients, the dentists, with high quality dentistry products and our esthetic dentistry products are second to none.

**Learn More About Lakeside Dental Lab:**

- **e max Dental Products** - Pressable technology, high strength glass ceramic, and 400 MPa flexural strength
- **Porcelain Dental Products** - Universal porcelain options, semi-precious porcelain crowns, and non-precious porcelain crowns
- **Z-Bruxzir Dental Products** - 100% full-milled pure zirconia restoration, 1,000 MPa flexural strength, and zirconia's aesthetic qualities

**Estimated Days In Lab:**

- E max Milled: 5 Days
- Porcelain 5 days
- Full cast 3 days
- Bruxzir 10 days
- 1 to 4 unit bridges 7 days
- 5 plus unit bridges please call
- Implants please call
- Excludes weekend and holidays

Our professional staff is here to answer any questions you have about our dental products.

Contact Lakeside Dental Lab today at [866-606-5958](tel:866-606-5958), or browse our website for more information about our dental products.

<http://ldwi.com/cudahy-wi-z-brux-dental-products.htm>



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### Z-Bruxzir Dental Products

Nation Wide

Z-Bruxzir is a 100% full-milled pure zirconia restoration; there is no porcelain overlay to create porcelain fractures. Due to the zirconia's aesthetic qualities and 1,000 MPa flexural strength, it's a great alternative to a PFM with a metal occlusal or a full-cast gold crown. Half the price of a gold crown, it offers adjustability and sustainability, excellent marginal fit, and conventional chamber prep and cementation.

For more information call [866-606-5958](tel:866-606-5958).

Contact Lakeside Dental Lab today at [866-606-5958](tel:866-606-5958), or browse our website for more information about our dental products or [e.max dental products](#).

## Exhibit E-10

<http://www.deepdyve.com/lp/elsevier/s21-a-overview-of-sleep-bruxism-history-and-on-the-way-we-are-C5GWtipE00>

S26

*2nd WASM World Congress, Bangkok, 4-8 February 2007 / Sleep Medicine 8 Suppl. 1 (2007) S11-S47*

**S21.A Overview of sleep bruxism: history and on the way we are**

T. Kato, *Institute for Oral Science, Matsumoto Dental University, Matsumoto, Japan*

Patients with sleep bruxism (SB) often complain of tooth wear, fracture of dental restorations, and orofacial pain/discomfort. Although early polysomnographic studies in 1960's and 1970's had already pointed out some important physiological aspects of the pathophysiology of SB, these results were not well recognized in the dental community. Rather, in the same era, the mechanistic concept that undesirable tooth contact pattern causes SB had emerged as more fancy and attractive mechanism for SB and associated clinical problems. Later on, several studies using portable/ambulatory recordings were carried out to assess sleep-related jaw muscle activity, which provided overall clinical pictures of SB in clinical dentistry, however, physiological basis of SB yet remained to be understood. During the last decade, polysomnographic studies with advanced technology and increased knowledge in sleep physiology have enhanced our understandings of the pathophysiology of SB: the genesis of SB is associated with arousal fluctuation during sleep. In addition, SB can occur in normal otherwise healthy population as well as in patients with sleep disorders such as sleep apnea, chronic pain, parasomnia, sleep-related movement disorders and neurologic diseases. Interactions between SB, sleep and orodental conditions can exist and the collaboration with sleep medicine and dentistry will introduce a new paradigm into clinical dentistry and related research fields.

**S21.B Orodental consequences associated with sleep bruxism**

K. Baba, *Department of Masticatory Function Rehabilitation, Graduate School, Tokyo Medical and Dental University, Japan*

Sleep bruxism (SB) has been defined as "involuntary rhythmic or spasmodic nonfunctional grinding or clenching of teeth during sleep". Many people with SB are unaware of the condition by themselves before dentists find visible evidence of tooth grinding on the tooth surface or they are told by their bed partner. The reported prevalence of SB has been estimated at 5 to 20 per cent of the total population.

Several sleep studies reported that the force of SB as evaluated by the masseter EMG may exceed the maximum conscious clenching level in some

adenotonsillectomy reduced the prevalence of bruxism in a group of 69 children with sleep disordered breathing from 45.6% to 11.8%. Meta-analysis of existing data and original data of the author will be presented.

**Conclusion:** SB is associated with SDB. Treatment of SDB may reverse SB in children.

**S21.D Dental devices used during sleep**

K. Yoshida, *Department of Oral and Maxillofacial Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan*

Dentists have used a variety of removable oral devices for the treatment of many diseases in the craniomaxillofacial region such as temporomandibular joint disorder, sleep bruxism, and craniofacial deformity. Intraoral appliances such as stabilization splint (a type of bite plate) are used at night for patients with temporomandibular joint disorder or sleep bruxism when they otherwise may grind their teeth more. Although there is insufficient evidence, it appears that stabilization splint therapy may be beneficial for reducing pain severity at rest and on palpation. Functional orthodontic appliances aimed to stimulate mandibular growth by forward posturing of the mandible is available to correct skeletal and occlusal disharmony. For the last twenty years, oral appliances have been successfully applied for the sleep apnea syndrome and primary snoring. The appliances are prescribed for the purpose of advancing the position of the mandible and tongue in order to enlarge the airway or reduce its collapsibility. Oral appliance therapy is an important treatment choice and may be preferred initial treatment for treatment of sleep-disordered breathing. Above-mentioned devices are used during sleep and some may disturb sleep of patients just after insertion of the devices. The mode and action of these devices, and putative influence on sleep and that after habituation period will be presented.

**S23. Sleeping problems and metabolism**

**S23.1 Symposium summary**

## Exhibit E-11

http://www.thejpd.org/article/0022-3913(61)90212-8/abstract

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Volume 11, Issue 2, Pages 363-374, March 1981
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Dysfunctional temporomandibular joint and muscle pain
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David B. Vantard, D. Compton
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Abstract
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References

**Abstract**

The relationship between occlusal disharmony and pain in the temporomandibular joint and adjacent muscles was tested clinically and electromyographically before and after occlusal adjustment on 32 patients. Various degrees of disharmony associated with psychologic tension and occlusal interferences were observed in all of the patients. Clinically, all patients experienced relief of the pain and discomfort after complete occlusal adjustment. Electromyographically, a harmonious and well synchronized contraction pattern of the temporal and masseter muscles was recorded after the adjustment. Any type of occlusal interference was found to trigger muscle spasms and pain, but the most consistent and significant interference was a discrepancy between centric relation and centric occlusion. The muscle disharmony was displayed electromyographically mainly in swallowing. The second most significant occlusal disharmony was balancing side interference. The balancing side contact had to be lighter than the working side contacts to establish a harmonious masticatory pattern. The patients' symptoms subsided without altering the vertical dimension. A close correlation was observed between the clinical and electromyographic recordings of occlusal interferences and muscle disharmony. However, electromyographic evidence of muscle balance in rest position could be obtained in more than one-half of the patients in spite of occlusal interference and temporomandibular joint pain. Masticatory contacts were seldom observed posterior to centric occlusion. However, the occlusal contacts in swallowing apparently occurred between centric occlusion and centric relation. The occlusal stability in centric relation was found to be of extreme importance for muscle harmony during swallowing. Rest position determined by conventional clinical methods did not always correspond to minimal, harmonious muscle activity electromyographically. A slight opening from the clinically determined rest position often (without the recording of an even, minimal contraction of the temporal and masseter muscles. The mandible could be opened from this position about 1/2 inch) further (a resting range) without eliciting any increased muscle activity from these muscles.

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## Exhibit E-12

http://www.thejpd.org/article/0022-3913(59)90051-4/abstract

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[« Back](#) **Journal of Prosthetic Dentistry**  
Volume 9, Issue 5, Pages 851-862, September 1959

Incisal and condylar guidance in relation to cuspal inclina lateral excursions

Lawrence A. Weinberg, A.B., D.D.S.

Received 23 September 1958

**Abstract** Abstract + References PDF References

**Abstract**

Some theoretic aspects of the incisal and condylar guidances in relation to the cusp inclines for lateral excursions have been presented. Since most patients exhibit signs of bruxism,<sup>13</sup> we must know more about the various guidances of the mandible that produce harmonious cuspal inclines in lateral excursions. These guidances have been related to the clinical problems of articulators.

No full text is available. To read the body of this article, please view the PDF online.

## Exhibit E-13

http://www.thejpd.org/article/0022-3913(59)90160-X/abstract

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[« Back](#) **Journal of Prosthetic Dentistry**  
Volume 9, Issue 6, Pages 1001-1016, November 1959

### Conservative occlusal rehabilitation

S. Charles Brecker, D.D.S.

Received 15 December 1958

**Abstract** [Abstract + References](#) [PDF](#) [References](#)

#### Abstract

Mathematics, engineering principles, precision, and uniformity of procedures must not dictate the physiology of occlusion. Failures in occlusal rehabilitation do not result from the use of, or the failure to use, a particular brand of instrument, or from the use of a particular technique of axis recording, or any other registration. Rather, they result from three basic errors. Unsuccessful results are obtained by increasing the vertical dimension of occlusion beyond the limits of the physiologic rest position, by disregarding the anatomical limitations in and around the mouth, and by rehabilitating natural dentitions in every case along the lines and planes recommended for complete denture construction. A "balanced" occlusion in a natural dentition is a fallacy.

It is important to duplicate the functional curve of occlusion in patients who have the habit of bruxism. Ten unfavorable factors of occlusion and their management should be understood by the dentist so that he will recognize the limitation of his knowledge and thereby avoid difficulty.

## Exhibit E-14

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**Exhibit \_\_-2**

<http://www.colonialdentallab.com/products.htm>

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## Expansion appliances:

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- Sagittals
- Schwarz Design
- Rapid Palatal Expander
- Nord
- PendeX



## Splints (bruxism):

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- TMJ Sprint (cold cure)
- Gelb-Mora
- Lars
- Impak Bionator
- Talon-type Brux Guard

## Exhibit \_\_-6

<http://www.bruxtech.com/home.html>

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Diagram of teeth showing: RIGHT, UPPER, LEFT, LOWER.

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**Exhibit \_\_-7**

<http://www.dentistrytoday.com/new-products/3499-zirconia-restoration-assured-dental-lab>

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## Exhibit \_\_-8

<http://www.jdtunbound.com/files/pdf-files/The%20Educated%20Technician.pdf>

*Full-contour zirconia captures the industry.*

## A Changing Direction in Dentistry: Full-Contour Zirconia

By Robin A. Carden

Zirconia is one of the most studied ceramic materials in the world for uses ranging from telecommunications to the new energy of the future to environmentally-friendly products. In clinical dentistry, it is widely used for the fabrication of crown copings, bridge frameworks and custom implant abutments. Its durability, biocompatibility, natural esthetics and low cost when compared to alternative restorative materials make it the ideal solution for a variety of clinical applications. More recently, dental use is trending toward full-contour (monolithic) zirconia — that is, solid zirconia restorations with no porcelain overlay. Ongoing material advancements have produced the strongest and most reliable all-ceramic restoration to date, making zirconia an ideal alternative solution wherever traditional metal or PFM restorations might be prescribed.



**Figure 1**  
(Above)  
Zirconia  
Powder

**Figure 2**  
(Right)  
BruZir  
Blanks

### Material Origins

Zirconia, or zirconium oxide, is the common name for the chemical compound zirconium dioxide ( $ZrO_2$ ). The material is commercially available in two basic forms. The first of these is naturally derived from the mineral Baddeleyite. The second is synthetically derived from zircon sand ( $ZrSiO_4$ ) using a solid state reaction process. Several oxides such as magnesium oxide ( $MgO$ ), yttrium oxide ( $Y_2O_3$ ), calcium oxide ( $CaO$ ), cerium (III) oxide ( $Ce_2O_3$ ),

and others are added to zirconia in order to stabilize the tetragonal and/or cubic phases. The resulting material, often referred to as yttria-stabilized zirconia (YSZ), exhibits superior strength and flexibility, surpassing the mechanical limitations of traditional fine ceramics.

### Material Advantages

The fast-growing popularity of full-contour zirconia is easy to understand when observing several material advantages:

1. **High Flexural Strength** — Full-contour zirconia products on the market today boast flexural strength ranging anywhere from 850 MPa to 1,465 MPa. These higher-level strength increases have been achieved through the use of post-powder processing. When compared to the flexural strength of porcelain ceramics, with typical ranges of 71 MPa (feldspathic porcelain) to 419 MPa (In-Ceram), the zirconia strength advantage becomes clear.
2. **High Fracture Toughness (K<sub>IC</sub> Value)** — Strength and toughness are not necessarily related. Brittle materials may exhibit significant tensile strength by supporting a



static load, whereas toughness indicates how much energy a material can absorb before mechanical failure. Also thought of as impact resistance, fracture toughness is a quantitative property that describes the ability of a material with inherent microstructural flaws to resist fracture via crack growth and propagation. A piece of lead or steel has high fracture toughness and will generally encounter ductile fracture, characterized by extensive plastic deformation prior to structural failure. Materials such as glass and traditional glass-ceramics typically exhibit low and inconsistent fracture toughness, and are prone to brittle fracture, characterized by a lack of apparent plastic deformation prior to structural failure. Thus, fracture toughness becomes one of the most important properties of any brittle material for virtually all design applications. The fracture toughness for partially stabilized zirconia is naturally high because of an internal mechanism that actually inhibits crack propagation. Inside, cubic grains are constraining the tetragonal precipitates that want to expand and release associated energy. When these grains are faced with a propagating crack tip, the tetragonal phase is released and allowed to change back to the



Figure 3 (Left)  
Monoloop BruxZr



Figure 4 (Below)  
Monoloop Full Cast

more stable monoclinic phase. This results in an associated volumetric expansion, effectively closing the advancing crack. Known as phase transformation toughening, this unique self-healing event gives partially stabilized zirconia a fracture toughness that is three to six times higher than normal zirconia and most other ceramics. Even so, ongoing methods are being devised to modify the yield strength, ductility and fracture toughness of both crystalline and amorphous materials, including zirconia. For instance, consolidation processes are being used to reduce grain size. Because crack propagation through a material's grain boundaries is deflected by the material's grains, a material consisting of smaller grains becomes inherently stronger, as there are more grains to absorb energy from the force of the crack.

Whereas a crack in a traditional ceramic travels all the way through the material with little inhibition, transformation toughening represents a breakthrough in achieving all-ceramic materials with a high value for fracture toughness. Today's partially stabilized zirconia is so tough that it can be struck with a hammer or fabricated into a hammer for driving nails.

3. Resistance to Thermal Shock — Zirconia has relatively low thermal expansion numbers, giving it

## Understanding Zirconia

**Names:** Zirconia, zirconium oxide, zirconium dioxide ( $ZrO_2$ ), yttria-stabilized zirconia (YSZ)

**Terms:**

**Phase Transformation Toughening:** The naturally occurring process by which cubic grains within stabilized zirconia constrain tetragonal precipitates, effectively closing advancing cracks and resulting in a sort of self-healing of the material.

**Fracture Toughness:** A property that describes the ability of a material with inherent microstructural flaws to resist fracture via crack growth and propagation.

**Plasticity:** The deformation of a material undergoing non-reversible changes of shape in response to applied forces.

**Brittle Fracture:** No apparent plastic deformation takes place before fracture.

**Ductile Fracture:** Extensive plastic deformation takes place, characterized by slow propagation and absorption of large amounts of energy, before fracture.

excellent resistance to thermal shock. This means it will remain very stable in the mouth and will face fewer stress factors resulting from expansion and contraction.

4. **Improved Esthetics** — If there has been a complaint regarding full-contour zirconia to date, it would be that its opaque white hue lacks the translucent, ivory shade of natural teeth. Zirconia can be stained and glazed to a prescribed tooth shade, but has still been limited by a lack of inherent translucency. However, consolidation processes in the laboratory that initially focused on improving strength through reduced particle size have led to related innovations in material translucency. These advancements, along with improved blending processes, allow the purest zirconia powder to be changed into an ivory shade that is more lifelike than the typical snow-white zirconia. Whereas full-contour zirconia is typically prescribed only for posterior restorations, newer clinical cases have shown it to blend in reasonably well with anterior teeth. These continuing enhancements in color and translucency, to go along with the elimination of dark gingival lines associated with traditional PFM restorations, give rising hope to full-contour zirconia becoming an acceptable anterior restorative.
5. **Improved Wear Compatibility** — Diamond-polishing a full-contour zirconia crown provides longterm life for opposing enamel surfaces. This wear compatibility has been validated in enamel wear in-vitro studies, and clinical studies are also under way. A 2010 comparative wear study conducted by professor Dr. J. Geis-Gerstorfer and sponsored by Glidewell Dental Laboratories used the Willytech Chewing Simulator to



**Figure 5** (Above)  
Monobloc Metal-Occlusal

simulate the clinical performance of both BruxZir Solid Zirconia and Ceramco<sup>®</sup>3 porcelain over a period of five years. The reported findings stated that, after 1.2 million wear cycles under a load of 5 kg, the wear of the antagonist situation (Stearite ball) was found to be significantly lower with BruxZir ( $72 \pm 21 \mu\text{m}$ ) than with Ceramco<sup>®</sup>3 ( $110 \pm 48 \mu\text{m}$ ).

6. **Cost** — A discussion of the benefits offered by full-contour zirconia would not be complete without mentioning cost factors. Despite its many material advantages, zirconia is considerably less expensive than traditional, precious metal.

### Indications

Full-contour zirconia is indicated for posterior crowns, crowns over implants and crowns with limited occlusal clearance. It is also indicated for full-arch bridges up to 14 units. Primary candidates include bruxers and grinders who do not desire cast gold or metal occlusal PFM restorations. For esthetic reasons, it is recommended that a facial veneer of porcelain be used on any zirconia-based anterior restoration. However, full-contour zirconia may be used in specific anterior cases where a dentist wishes to emphasize the strength of the restoration over its esthetics.

### Availability

Commercially available zirconia blanks for in-lab milling include brands such as BruxZir, Sagemax HT, Crystal Diamond Zirconia, Zirlux, Prettau and

### JDT Unbound

The Journal of Dental Technology and JDT Unbound have covered zirconia extensively. Search our archives at [www.jdtunbound.com](http://www.jdtunbound.com) to find out more about this material.

Origin. Prescribed crowns include brands such as BruxZir, Suntech FC, Z-Brux, and TRICONia.

Due to its high flexural strength, high fracture toughness, resistance to thermal shock, metal-free esthetics and terrific wear comparability, full-contour zirconia is an ideal material for dental restorations. It also boasts excellent contours and contacts for desired marginal fit, conventional chamfer prep and cementation, and affordability for both clinicians and their patients. Prescribed almost exclusively for posterior restorations, material advancements may make it an acceptable solution for some anterior restorations as well, further fueling its popularity as the material of choice for dental restorations today. **JDT**

### About the Author:



Carden founded Talon Composites, the manufacturer of Talbar, a composite material that uses advanced ceramics and metals. To date, he holds more than 25 patents, mostly related to metal and ceramic composites. In 1998, he won the Design Engineering Award from Design News. He is also the inventor of the translucent orthodontic braces for 3M<sup>TM</sup> ESPE<sup>TM</sup> and Ceradyne Inc. Presently, he works at Glidewell Laboratories as senior director of research and development.

## Exhibit \_\_-9

<http://ldlwi.com/index.htm>

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## Exhibit \_\_-10

<http://www.deepdyve.com/lp/elsevier/s21-a-overview-of-sleep-bruxism-history-and-on-the-way-we-are-C5GWtipE00>

S26

*2nd WASM World Congress, Bangkok, 4-8 February 2007/Sleep Medicine 8 Suppl. 1 (2007) S11-S47*

**S21.A Overview of sleep bruxism: history and on the way we are**

T. Kato, *Institute for Oral Science, Matsumoto Dental University, Matsumoto, Japan*

Patients with sleep bruxism (SB) often complain of tooth wear, fracture of dental restorations, and orofacial pain/discomfort. Although early polysomnographic studies in 1960's and 1970's had already pointed out some important physiological aspects of the pathophysiology of SB, these results were not well recognized in the dental community. Rather, in the same era, the mechanistic concept that undesirable tooth contact pattern causes SB had emerged as more fancy and attractive mechanism for SB and associated clinical problems. Later on, several studies using portable/ambulatory recordings were carried out to assess sleep-related jaw muscle activity, which provided overall clinical pictures of SB in clinical dentistry, however, physiological basis of SB yet remained to be understood. During the last decade, polysomnographic studies with advanced technology and increased knowledge in sleep physiology have enhanced our understandings of the pathophysiology of SB: the genesis of SB is associated with arousal fluctuation during sleep. In addition, SB can occur in normal otherwise healthy population as well as in patients with sleep disorders such as sleep apnea, chronic pain, parasomnia, sleep-related movement disorders and neurologic diseases. Interactions between SB, sleep and orodental conditions can exist and the collaboration with sleep medicine and dentistry will introduce a new paradigm into clinical dentistry and related research fields.

**S21.B Orodental consequences associated with sleep bruxism**

K. Baba, *Department of Masticatory Function Rehabilitation, Graduate School, Tokyo Medical and Dental University, Japan*

Sleep bruxism (SB) has been defined as "involuntary rhythmic or spasmodic nonfunctional grinding or clenching of teeth during sleep". Many people with SB are unaware of the condition by themselves before dentists find visible evidence of tooth grinding on the tooth surface or they are told by their bed partner. The reported prevalence of SB has been estimated at 5 to 20 per cent of the total population.

Several sleep studies reported that the force of SB as evaluated by the masseter EMG may exceed the maximum conscious clenching level in some

adenotonsillectomy reduced the prevalence of bruxism in a group of 69 children with sleep disordered breathing from 45.6% to 11.8%. Meta-analysis of existing data and original data of the author will be presented.

**Conclusion:** SB is associated with SDB. Treatment of SDB may reverse SB in children.

**S21.D Dental devices used during sleep**

K. Yoshida, *Department of Oral and Maxillofacial Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan*

Dentists have used a variety of removable oral devices for the treatment of many diseases in the craniomaxillofacial region such as temporomandibular joint disorder, sleep bruxism and craniofacial deformity. Intraoral appliances such as stabilization splint (a type of bite plate) are used at night for patients with temporomandibular joint disorder or sleep bruxism when they otherwise may grind their teeth more. Although there is insufficient evidence, it appears that stabilization splint therapy may be beneficial for reducing pain severity at rest and on palpation. Functional orthodontic appliances aimed to stimulate mandibular growth by forward posturing of the mandible is available to correct skeletal and occlusal disharmony. For the last twenty years, oral appliances have been successfully applied for the sleep apnea syndrome and primary snoring. The appliances are prescribed for the purpose of advancing the position of the mandible and tongue in order to enlarge the airway or reduce its collapsibility. Oral appliance therapy is an important treatment choice and may be preferred initial treatment for treatment of sleep-disordered breathing. Above-mentioned devices are used during sleep and some may disturb sleep of patients just after insertion of the devices. The mode and action of these devices, and putative influence on sleep and that after habituation period will be presented.

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**S23. Sleeping problems and metabolism**

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**S23.1 Symposium summary**



**Exhibit \_\_-11**

[http://www.thejpd.org/article/0022-3913\(61\)90212-8/abstract](http://www.thejpd.org/article/0022-3913(61)90212-8/abstract)

The Journal of Prosthetic Dentistry

Volume 11, Issue 2, Pages 353-374, March 1981

**Dysfunctional temporomandibular joint and muscle pain**

David P. Maitland & G. C. Maitland

**Abstract** [Abstract + References](#) [PDF](#) [References](#)

**Abstract**

The relationship between occlusal disharmony and pain in the temporomandibular joint and adjacent regions was tested clinically and electromyographically before and after occlusal adjustment on 32 patients. Various degrees of bruxism associated with psychical tension and occlusal interferences were observed in all of the patients. Clinically, all patients experienced relief of the pain and discomfort after complete occlusal adjustment. Electromyographically, a harmonious and well-synchronized contraction pattern of the temporal and masseter muscles was recorded after the adjustment. Any type of occlusal interference was found to trigger muscle spasms and pain, but the most consistent and significant interference was a discrepancy between centric relation and centric occlusion. The muscle disharmony was displayed electromyographically mainly in swallowing. The second most significant occlusal disharmony was balancing side interference. The balancing side contact had to be lighter than the working side contacts to establish a harmonious masticatory pattern. The patients' symptoms subsided without altering the vertical dimension. A close correlation was observed between the clinical and electromyographic recordings of occlusal interferences and muscle disharmony. However, electromyographic evidence of muscle balance in rest position could be obtained in more than one-half of the patients in spite of occlusal interference and temporomandibular joint pain. Masticatory contacts were seldom observed posterior to centric occlusion. However, the occlusal contacts in swallowing apparently occurred between centric occlusion and centric relation. The occlusal stability in centric relation was found to be of extreme importance for muscle harmony during swallowing. Rest position determined by conventional clinical methods did not always correspond to minimal, harmonious muscle activity electromyographically. A slight opening from the clinically determined rest position often facilitated the recording of an even, minimal contraction of the temporal and masseter muscles. The mandible could be opened from this position about 1/2 inch further (a resting range) without eliciting any increased muscle activity from these muscles.

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**Dental Advance**

**Exhibit \_\_-12**

http://www.thejpd.org/article/0022-3913(59)90051-4/abstract

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Volume 9, Issue 5, Pages 851-862, September 1959

Incisal and condylar guidance in relation to cuspal inclina lateral excursions

Lawrence A. Weinberg, A.B., D.D.S.

Received 23 September 1958

**Abstract** [Abstract + References](#) [PDF](#) [References](#)

**Abstract**

Some theoretic aspects of the incisal and condylar guidances in relation to the cusp inclines for lateral excursi been presented. Since most patients exhibit signs of bruxism,<sup>13</sup> we must know more about the various guid mandible that produce harmonious cuspal inclines in lateral excursions. These guidances have been related clinical problems of articulators.

No full text is available. To read the body of this article, please view the PDF online.

## Exhibit \_\_-13

http://www.thejpd.org/article/0022-3913(59)90160-X/abstract

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[« Back](#) **Journal of Prosthetic Dentistry**  
Volume 9, Issue 6, Pages 1001-1016, November 1959

### Conservative occlusal rehabilitation

[S. Charles Brecker, D.D.S.](#)

Received 15 December 1958

[Abstract](#) [Abstract + References](#) [PDF](#) [References](#)

#### Abstract

Mathematics, engineering principles, precision, and uniformity of procedures must not dictate the physiology of occlusion. Failures in occlusal rehabilitation do not result from the use of, or the failure to use, a particular brand of instru-  
ments, or from the use of any one of the various methods of axis recording, or any other registration. Rather, they result from three basic errors. Unsuccessful results are obtained by (1) by increasing the vertical dimension of occlusion beyond the limits of the physiologic rest position, by disregarding the anatomical and physiological limitations in and around the mouth, and by rehabilitating natural dentitions in every case along the lines and patterns recommended for complete denture construction. A "balanced" occlusion in a natural dentition is a fallacy.

It is important to duplicate the functional curve of occlusion in patients who have the habit of **bruxism**. Ten unfavorable factors in occlusion and their management should be understood by the dentist so that he will recognize the limitation of his knowledge and thereby avoid difficulty.

## Exhibit \_\_-14

<http://teeth-grinding.blogspot.com/>

**Teeth Grinding (Bruxism)**  
The problem in Bruxism is that the Bruxer is not aware that he Grinds.

**Tuesday, February 26, 2008**  
**Malocclusion – Natural Born K... Bruxers!**

Malocclusion is a condition in which teeth are misaligned. When the teeth are misaligned there is abnormal friction between the teeth, and when the patient grinds or clenches his teeth the results are more severe.

There are several types of Malocclusion. These types differ in the way the teeth are misaligned. These types are:

**Spacing**  
Spacing is a condition where there is a gap between the teeth. This occurs when the teeth are very small compared to the available space within the jaw.

**Crowding**  
Crowding is a condition where there is a lack of space for all the teeth to fit normally side by side within the jaw. In case of crowding the teeth are positioned one on top of the other.

**Over bite**  
Over bite is a condition where the front teeth overlap the lower teeth in an excessive manner.

**Under bite**  
Under bite is a condition where the lower teeth extend past the upper front teeth.

**Deep bite**  
Deep bite is a condition where the upper/lower teeth touch the lower/upper gum tissue instead of the lower/upper teeth.

**Open bite**  
Open bite is a condition where there is a gap between the upper and lower front teeth even when the jaw is clenched closed.

All types of Malocclusion might lead to Bruxism or make Bruxism worse. Malocclusion can be treated by tooth extraction, dental braces or dental surgery. Bruxism resulting from Malocclusion can be avoided by applying a night guard.

In most cases Malocclusion should be treated for aesthetic reasons even if no Bruxism is caused.

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Posted by KobiT at 2:24 PM 48 comments

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